LIDGETTONIA, A NEW TYPE OF FERTILE *GLOSSOPTERIS*

H. HAMSHAW THOMAS

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 3 No. 5
LONDON : 1958

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)

GEOLOGY

The following papers appeared in Volume I (1949–52):

	Price
No. 1 (1949). The Pterobranch *Rhabdopleura* in the English Eocene. H. D. Thomas & A. G. Davis	7*s.* 6*d.*
No. 2 (1949). A Reconsideration of the Galley Hill Skeleton. K. P. Oakley & M. F. Ashley Montagu	5*s.*
No. 3 (1950). The Vertebrate Faunas of the Lower Old Red Sandstone of the Welsh Borders. E. I. White *Pteraspis leathensis* White, a Dittonian Zone-Fossil. E. I. White	7*s.* 6*d.*
No. 4 (1950). A New Tithonian Ammonoid Fauna from Kurdistan, Northern Iraq. L. F. Spath	10*s.*
No. 5 (1951). Cretaceous and Eocene Peduncles of the Cirripede *Euscalpellum* T. H. Withers	5*s.*
No. 6 (1951). Some Jurassic and Cretaceous Crabs (Prosoponidae). T. H. Withers	5*s.*
No. 7 (1952). A New *Trochiliscus* (Charophyta) from the Downtonian of Podolia. W. N. Croft	10*s.*
No. 8 (1952). Cretaceous and Tertiary Foraminifera from the Middle East. T. F. Grimsdale	10*s.*
No. 9 (1952). Australian Arthrodires. E. I. White	15*s.*
No. 10 (1952). Cyclopygid Trilobites from Girvan. W. F. Whittard	6*s.*

The following papers appeared in Volume II (1953–56):

No. 1. (1953). The Deer of the Weybourn Crag and Forest Bed of Norfolk. A. Azzaroli	£1 5*s.*
No. 2 (1953). A Coniferous Petrified Forest in Patagonia. M. G. Calder	12*s.*
No. 3 (1953). The Solution of the Piltdown Problem. J. S. Weiner, K. P. Oakley & W. E. Le Gros Clark	3*s.* 6*d.*
No. 4 (1954). Some Upper Cretaceous and Eocene Fruits from Egypt. M. E. J. Chandler	16*s.*
No. 5 (1954). The Carboniferous Flora of Peru. W. J. Jongmans	15*s.*
No. 6 (1955). Further Contributions to the Solution of the Piltdown Problem. J. S. Weiner, W. E. Le Gros Clark & K. P. Oakley *et al.*	£1
No. 7 (1955). The Schizaeaceae of the South of England in Early Tertiary Times. M. E. J. Chandler	15*s.*
No. 8 (1956). The Brachyopid Labyrinthodonts. D. M. S. Watson	£1

LIDGETTONIA, A NEW TYPE OF FERTILE *GLOSSOPTERIS*

BY

H. HAMSHAW THOMAS, F.R.S.

Pp. 177–189 ; *Pls.* 22–23 ; 2 *Text-figures*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 3 No. 5
LONDON : 1958

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

This paper is Vol. 3, *No.* 5 *of the Geological series.*

PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM

Issued February, 1958

Price Five Shillings

LIDGETTONIA, A NEW TYPE OF FERTILE *GLOSSOPTERIS*

By H. HAMSHAW THOMAS

SYNOPSIS

Reproductive organs of two kinds have already been described attached to leaves of *Glossopteris*. Cuticle studies suggest that this leaf is a form genus and that it was borne on plants of several different types. The present paper describes leaves of another species which are accompanied by fertile scale leaves bearing a number of delicate stalked cupules. The cupules are empty but the matrix around them contains the remains of a very large number of empty sporangia and of many small seeds. There was thus a third or perhaps a fourth genus of plants with leaves of the *Glossopteris* type.

INTRODUCTION

THE genus *Glossopteris* was instituted by Brongniart (1828) for leaves which were entire, more or less lanceolate, with a midrib and fine secondary veins which showed dichotomy and anastomosis. Two forms were mentioned as belonging to the new group, *G. browniana* from Australia and India, and *G. nilsoniana* from Hör in Sweden. Subsequently Brongniart added two further forms, *G. angustifolia* from India and *G. phillipsi* from Yorkshire. Thus at the outset *Glossopteris* was a form or artificial genus. The two European Mesozoic species were separated by Sternberg (1838) and placed in the genus *Sagenopteris*; they have proved to be leaflets of members of the Caytoniales. The position of the remainder was uncertain, but the study of their cuticular structure has shown that there are considerable differences in the epidermal cells of other species of *Glossopteris*. Zeiller (1896), Sahni (1923) and Harris (1932) described the differing cuticles of three species, and recently Srivastava (1956) has added considerably to our knowledge by descriptions of the cuticles of fourteen additional species. Surange & Srivastata (1956) have suggested that on this evidence six groups, possibly of generic rank, may be recognized. All the epidermal structures suggest that the leaves known as *Glossopteris* and *Gangamopteris* belonged to seed-bearing plants. Mrs. Plumstead (1952, 1956) has shown that this view is true for five species, and although the preservation of her material makes its interpretation very uncertain, it seems likely that the five species belong to two genera which she has named *Scutum* and *Lanceolatus*.

The paper which follows shows that another species with *Glossopteris* leaves, produced what must have been reproductive structures of a different type on small leaves of the form called by some previous authors scale leaves. These are quite distinct from *Scutum* and *Lanceolatus*, and merit the creation of a new genus. *Glossopteris* was thus a leaf type belonging to several unrelated genera. It is still a

form genus and confusion is likely if it is used in the designation of a taxon of higher rank as has been recently suggested (Plumstead, 1956*a*).

The material. The specimens here described were obtained from a narrow bed of shale, 2–3 ft. thick, exposed in the sides and bed of a small stream on the estate of Mr. S. Thomson at Lidgetton, about 35 kilometres north-west of Pietermaritzburg, Natal, South Africa. This plant bed was originally discovered by Mr. A. D. O. Mogg, he kindly sent two large blocks to the author, who visited the locality in 1929* and made a collection of specimens, which have only recently been studied. The plant remains occur in fine-grained shale which varies in colour and character along the stream. In some places the rock is compact, dark in colour, and often nearly black. The plants are well preserved as black carbonaceous compactions, but are difficult to photograph because of the lack of contrast with the matrix (see Pl. 22, fig. 1). At other places the matrix is coarser and light grey in colour, the plant remains being less highly compressed. This again grades into fine-grained material of a pale buff colour, in which the plant substance has entirely disappeared, or is represented by ferruginous material lacking any trace of epidermal structure (Pl. 22, fig. 3).

The macroscopic remains of plants in the accessible parts of this bed were of two main types. A series of leaves of various sizes referable to the genus *Glossopteris*, and including a number of shorter forms without a midrib, of the type called scale leaves by previous authors. With these, towards the bottom of the bed, are parts of equisetalean plants, stems, pith-casts, branches and leaves. These may belong to the form called by Du Toit (1927 : 315) *Neocalamites carreri* Zeiller, but, from the more abundant material present in this collection, it is clear that the plant differed very considerably from the species described by Zeiller. In addition to these larger remains there are very large numbers of detached sporangia scattered in the matrix, and many isolated seeds of a uniform size and form.

Age of the specimens. The organic remains in the bed furnish no clear indications of its age, and there is a heavy cover of soil and vegetation in the area. According to the latest map published by the Geological Survey of South Africa the outcrop is of Ecca age in the Karroo System. The boundary between the Ecca and the Beaufort series is not far distant, and it is thus possible that the material is of Upper Ecca age. But there is little lithological difference between the rocks of the Ecca and those of the Beaufort series, as is stated by Du Toit, and it is also possible that the forms described are of Beaufort age. In any event they are appreciably younger than the fertile forms described by Mrs. Plumstead.

Genus ***LIDGETTONIA*** nov.

Diagnosis. Sterile leaves of *Glossopteris* type, simple, lanceolate ; strong tuberculate midrib almost to apex ; veins numerous, close, ascending ; forking and anastomosing ; meshes narrow elongated, longer near midrib. Fertile leaves distinct, short, spathulate-lanceolate ; midrib absent ; veins spreading from base,

* The author's thanks are due to the late Mr. J. A. Lidgett and to Mr. G. C. Lidgett who gave valuable assistance in the re-discovery and working of the bed.

forking and anastomosing ; meshes considerably larger than in sterile leaves ; lower (?) surface with two longitudinal rows of 4–6 small cupules on slender stalks, arising from petiole or basal portion of leaf ; cupules open campanulate or disc-like, finely striated, margins lobed.

Differences from comparable forms (*Scutum, Lanceolatus*) :

Several small cupules with slender stalks borne on small leaves differing from the sterile leaves in size, shape and venation, instead of a single, large, bifid cupular structure on a stout pedicel springing from the midrib or petiole of a leaf of normal size and venation and containing massive fertile structures.

TYPE SPECIES. *L. africana* n. sp.

Lidgettonia africana n. sp.

(Plates 22, 23 ; Text-figs. 1, 2)

DIAGNOSIS. As for genus.

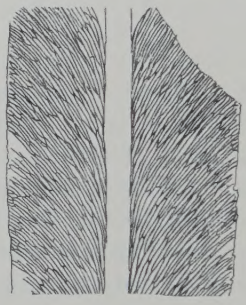
HOLOTYPE. Fertile leaf with remains of cupules on either side of the petiole. (Brit. Mus. N.H. No. V. 34633.)

DESCRIPTION. *Sterile leaves* : Most of the specimens are the remains of sterile leaves (Pl. 22, fig. 1). From their simple, lanceolate form, their well-developed midrib and their crowded anastomosing veins, they are clearly referable to the form genus *Glossopteris*. They vary considerably in size, their venation is uniform, but differs somewhat in appearance on the two sides of the leaf, and there is no reason to suppose that more than one species is represented. No complete leaf has been found, the longer pieces are about 15 cm. in length and 2·5–3 cm. broad in their widest part. The lamina tapers very gradually towards the base, where the petiole was 4–5 mm. broad. The length of the petiole is unknown, it is more than 2 cm. in some examples, but in no case is its base visible. Towards the apex the lamina tapers to a blunt tip. In the larger specimens the midrib is visible to within a short distance from the apex. Below it merges without marked change into the petiole. As it becomes broader it has a characteristic appearance due to the presence of small rounded projections, 0·3–0·5 mm. in diameter, probably indicating the presence of groups of hard cells in the original tissue. In addition, the well preserved specimens show a series of slender longitudinal ridges, probably due to lines of thicker epidermal or hypodermal cells.

The secondary veins are very numerous and crowded (Text-fig. 1). They leave the midrib at a very acute angle, and often run parallel to it at first for about 5 mm., then curving outwards they run steeply to the margin, diverging from the midrib at an angle of 30°–40°. Between the midrib and the margin they show frequent cross connections and they fork in an irregular way so that the number of veins reaching the margin is rather more than double the number which leave the midrib. Near the centre of the leaf the secondary veins are about 0·6 mm. apart, near the margin they are only 0·3–0·4 mm. distant. The anastomoses of the veins are either by small transverse veinlets, or by the fusion of veins which have come from dichotomies at a lower level. The areolae are elongated and fusiform, becoming shorter

near the margin. In some hand specimens the anastomoses of the veins can only be seen clearly in the lower part of the leaf and near the midrib. In the rather rare cases where the lower surface of the leaf is seen the veins appear thicker and very close together. The strength of the veins probably rendered possible the appearance of the specimen represented in Text-fig. 1 ; here almost all of the tissue of the lamina had disappeared leaving the midrib and the veins clearly seen in the matrix, but the junction of the veins with the midrib was obscured in some places.

The surface of the upper side of well-preserved specimens shows, under the binocular microscope, fine ridges above the secondary veins ; five such ridges are visible following the course of the larger veins, some of them branching off when the vein forks. Towards the margin of the leaf only one such ridge is seen. The outlines of the epidermal cells are frequently visible, these cells were elongated above the veins and rounded and isodiametric between the veins.



TEXT-FIG. 1.—Part of a sterile leaf showing the venation. Drawn from a photograph of a specimen in which only the midrib and the veins were preserved. Nat. size. (V.34639).

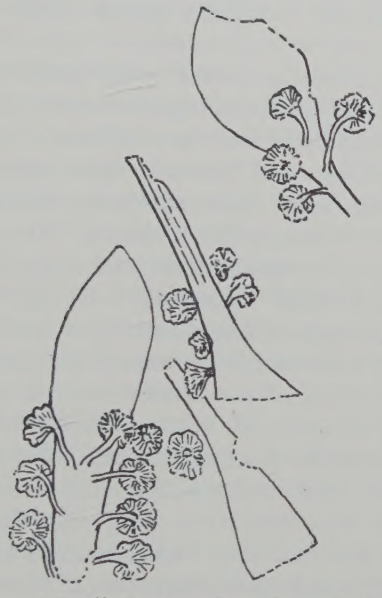
Although the preservation of some specimens appears very good it has proved impossible, as yet, to obtain cuticle preparations, evidently the cuticle was very thin and breaks into tiny fragments when stripped from the matrix.

Scale leaves. The leaves which have been described above are accompanied by a number of smaller leaves, 2–6 cm. long and 1–1·5 cm. broad. They often show a broad base and little or no trace of a midrib. Their veins are coarser, more distant and show frequent anastomoses. Such structures have been described by previous authors (see Arber 1905*a*) under the somewhat inappropriate name of scale-fronds. They probably were organs intermediate between the normal photosynthetic leaves and the fertile structures now to be described.

Fertile leaves. A large slab of grey shale, showing many compressed leaves, and very similar to the specimen shown in Pl. 22, fig. 1, contains the remains of four shorter leaves close together (Text-fig. 2). They appear to have been very thin and present little contrast with the matrix. All are incomplete but three of them are contracted at the base to form a petiole ; they show anastomosing veins but no midrib. When examined in a strong beam of oblique light three of them were found to bear small lateral appendages springing from their basal portions. These structures are small campanulate bodies or peltate discs, 5–6 mm. in diameter,

borne on slender stalks about 5 mm. long and 0·6 mm. wide. They sprang from the surface of the leaf and appear to have been produced in two rows, one on either side of the longitudinal axis of the leaf. Fine striations, probably due to elongated epidermal cells run from the stalks to the margins of the discs, which in the best preserved specimens are seen to have a number of small lobes. One of the four leaves in this group shows no appendages, but there are some small discs close to it which may have sprung from the surface embedded in the matrix.

None of these structures contains any sporangia or seeds, but it seems highly probably that they originally contained such reproductive organs. From a comparison with the pteridosperms they may be termed cupules.



TEXT-FIG. 2.—Group of fertile leaves, showing stalked cupules. Nat. size.

A second specimen (Pl. 23, fig. 4) shows a similar leaf preserved in a light grey shale, the plant tissue being less compressed and altered. The apical part of the lamina is not seen, at the top the lamina is 12 mm. broad, it tapers in a distance of 4 cm. to a petiole-like base, one and a half millimetres broad. In the expanded portion fine veins run upwards and outwards from the basal region, there is no midrib. As in the sterile leaves the epidermal cells above the veins were elongated while those in the meshes were isodiametric and rounded. The petiolar portion shows the remains of lateral appendages differing somewhat in appearance from those described above, probably owing to the different preservation. Their stalks are not clearly seen, they probably sprang from the lower side of the petiole. Parts of four cupules can be detected on one side and parts of three on the other margin of the petiole; most of them are laterally compressed and are somewhat hemispherical in outline. One example, 3 mm. in diameter, shows some of the marginal

lobes. In two places parts of seeds, like those to be described later, are seen in contact with cupules; they may possibly have been extruded when the original structure became compressed in the matrix.

Another example shows a different type of preservation (Pl. 22, fig. 2). The plant substance is converted to structureless red matter. The lamina has a different shape, lacking the petiole-like base and the expanded upper portion; it is 3 cm. long, about 7 mm. broad at its widest part, and 5 mm. broad at the base. The remains of six or possibly of seven cupules are seen on one margin, with indications of two or three on the other margin. The stalks of several of them are seen on the surface of the lamina but their exact place of origin cannot be determined. Some of the cupules are conical in form, others appear as flattened discs. A well preserved seed is seen lying in contact with one of the cupules, but its position may have been accidental.

The form of the cupules is clearly shown in the specimen figured in Pl. 22, fig. 3. Here the plant remains are reddish impressions or moulds in a light coloured matrix, all the plant tissue has disappeared but the outlines of the original structures are very clearly seen. The specimen and its counterpart show the impressions of seven stalked cupular discs, which, from their positions, were probably attached to a fertile leaf embedded in the matrix and not visible. The stalks of four of them are more or less parallel and probably sprang from near one margin while three probably came from near the other margin. The stalks are 0·7 mm. broad, they seem to have expanded to form a somewhat thicker central portion of the cupule, about 3 mm. in diameter, surrounded by a thinner zone, 2 mm. wide, with a lobed margin. The surface of the outer zone shows a series of undulations associated with the lobes and the whole is traversed by a series of fine radial striations. The cupules were empty at the time of preservation, a seed is seen lying near to them. The same hand-specimen contains also the remains of a scale leaf which is shown in the lower part of Pl. 22, fig. 3. This is about 2 cm. long, narrow at the base but quickly broadening to a width of 1 cm. and then rapidly contracting. No cupules are seen attached to this leaf, but the remains of fragments of tissue and also surface irregularities suggest that it may also have been fertile.

The specimens described show that associated with leaves of typical *Glossopteris* form there were small (scale) leaves with a venation of the *Gangamopteris* type. These structures often bore on their lower (?) surface rows of small and delicate stalked cupular structures. It is very difficult to explain the presence of these cupules except on the hypothesis that they formed the place of origin of the reproductive structures of the plant. But there is at present no certain direct evidence that this was true.

Sporangium-like organs. Arber (1905, 1905*a*) described some characteristic structures from several localities in New South Wales which he designated sporangium-like structures. Almost identical structures are present in considerable numbers in the Lidgetton shales associated with the plants just described. Isolated examples occur abundantly, but they are also found in circular or elongated groups about 1 cm. in diameter (Pl. 23, figs. 5, 6). The individual structures have a very characteristic appearance, they are usually elliptical or ovoid in shape but sometimes

appear to have had one side flattened or concave, others are fusiform (Pl. 23, fig. 7). They measure 1–1·5 mm. long and about 0·7 mm. broad. Well-preserved examples show a series of longitudinal anastomosing ridges, these appear to have been specially thickened cell walls which are more resistant than the rest of the wall substance to maceration. Some of the specimens described by Arber show a " neck-like prolongation " at one end, this was believed to be the part by which the sporangium was attached to the organ on which it was borne. No evidence of a similar prolongation has been found in the present specimens.

A number of these organs were removed from the rock and macerated in acid oxidizing liquid. They dissolved away completely when transferred to dilute ammonia leaving no trace of spores, but some of them contained a little of the matrix material. Either the sporangia were completely empty when preserved or the spores were not cutinized with material withstanding acid maceration. Several of the fusiform specimens (like those shown in Pl. 23, fig. 7) appear to have a longitudinal slit probably representing the line of dehiscence. Though these structures do not appear to contain spores the matrix contains large numbers of winged spores of different sizes which are seen when pieces of the rock are dissolved in hydrofluoric acid. Although there seems to be no proof that the structures in question were sporangia or that they had any connection with the plants described above, it seems difficult, in view of their large numbers, to regard them as unconnected. They do not resemble the sporangia of Equisetalean plants, and in each of the seven places where they have been found they are associated with *Glossopteris*. But it is possible that they were derived from some plant not represented by macroscopic remains in the present collection.

Isolated seeds. Mention has already been made of the presence of many isolated seeds in close proximity to the sterile and fertile leaves. A considerable number of these structures is present in the collection, and they are very uniform in size and shape (Pl. 22, figs. 2, 3 ; Pl. 23, fig. 5). They are almost circular in outline, and between 2 and 3 mm. in diameter, some of them are slightly flattened at their base. They show two distinct portions, a central elliptical part evidently composed of thick walled tissue, the sclerotesta, and a thinner peripheral part, or wing, which does not seem to extend round the base of the seed. In the centre the sclerotesta measures about 1·3 mm. across and the wing is about 0·8 mm. wide. Almost all the examples have the same shape, which seems to show that the seeds were originally flattened in form and that the rim round the sclerotesta had the form of a wing and was not due to the squashing of a soft sarcotesta during preservation. Had the original structures been spherical the appearance of the specimens would have varied somewhat. In some specimens (Pl. 22, fig. 2) there is a slight indentation in the wing at the apical end, in others the wing appears to extend beyond the apex of the sclerotesta and shows a projecting point. No clearly defined micropylar canal can be seen and there was no apical extension of the sclerotesta. No definite traces of vascular tissue can be seen but in well preserved specimens there may be concentric striations in the wing-like portion.

It would seem quite certain that these structures are the remains of seeds, and that their size is such that they may have grown inside the cupular structures described

above. But the specimens in the present collection do not establish this suggestion, and much more material is needed.

COMPARISON WITH OTHER FORMS

A comparison of the sterile leaves from Lidgetton with those of the many species that have been described is somewhat difficult and is probably untrustworthy in the absence of cuticle preparations. In general form they resemble some of the specimens that have been described as *G. indica* but they must belong to a different type, probably to a distinct genus, because the fertile leaves are not at all similar to those described by Mrs. Plumstead (1956) and found to bear reproductive organs of the *Scutum* type.

They most closely resemble the specimens described and figured by Feistmantel (1881) as *G. communis*. These had an acute apex, a gradually tapering lamina at the base, closely crowded veins which run out to the margin at an acute angle, especially near the tip of the leaf. The midrib was similar in being relatively broad and distinct below but thinning out at the apex. Feistmantel noticed small rounded projections on the midrib and the petiole, which he said had not been found on any other species ; they are shown as rather smaller structures than those of the Lidgetton leaves.

Another comparable form is the species named by Srivastava (1956) *G. arberi*, but in this there is said to be not much difference in the size of the meshes at the midrib and the margin, while in the present specimens the difference in size is very noticeable.

It may be mentioned that the Lidgetton leaves are quite unlike the forms from the Molteno beds of the Upper Umkomaas, Natal, which the author described under the inapplicable name of *G. longicaulis* (Hamshaw Thomas, 1952).[1]

The specimens which have been described above as fertile leaves have little in common with the reproductive structures described by Mrs. Plumstead (1952, 1956) from the Middle Ecca at Vereeniging. Although, owing to their mode of preservation the morphological nature of these objects is still, in my view, uncertain, they were large structures borne on a stout pedicel which arose from the midrib of a normal foliage leaf. At the top of the pedicel was a cupule-like structure divided into two halves, and containing a massive cone-like structure composed of a number of closely packed bodies, probably containing seeds. The smallest specimen of *Scutum* was more than three times the size of any of the cupules here described. The only feature in common is that both were produced on foliar organs. In view of the essential differences between the structures now discovered and those formerly described, it seems desirable to make a new genus for their reception, in spite of the fact that so many of the details of their structure are unknown. The name of *Lidgettonia* is proposed for their designation.

It has already been mentioned that the sporangia seen at Lidgetton closely resemble

[1] In transferring the plant which Du Toit (1927) had named *Sagenopteris longicaulis* to the form genus *Glossopteris*, the fact was overlooked that Feistmantel had previously used the name *longicaulis* for a different plant. Since the name was preoccupied it is proposed that the specimens from the Molteno Series of the Upper Umkomaas described and figured by Hamshaw Thomas (1952) should be named *Glossopteris verticillata* Thomas instead of *Glossopteris longicaulis* (Du Toit).

those described by Arber (1905) as sporangium-like organs. After the examination of a large number of these structures in the present collection there seems to be no reason for doubt that they are really the remains of sporangia. Our inability to find in them the remains of cutinized spores may be due to the unsuitability of our methods of treating the material or the spores may have been only lightly cutinized. It may be noticed that the specimens described by Arber were also associated with leaves of the normal type (*G. browniana*) and with " scale fronds ", they came from two localities in New South Wales. He also referred to the discovery by Zeiller (1896) of an example from the Transvaal among fronds and scale leaves of *Glossopteris*.

Arber drew attention to the similarity between his sporangia and those of the Recent cycad, *Stangeria*. He suggested the possible affinity of *Glossopteris* with the Pteridosperms. Recent work gives strong support to this view. It may therefore be noticed that the sporangia may be further compared with those of the pteridosperm *Pteruchus*, which occurs in the somewhat younger (Molteno) Beds of Natal. Both are alike in size and shape, though those of *Pteruchus* have a broad basal attachment. Both show longitudinal striations and a similar mode of dehiscence.

Similar sporangia were described by Seward (1908) from Zululand, by Lundquist (1919) from Brazil, and by Walkom (1928) from New South Wales, all associated with *Glossopteris* leaves but without evidence as to their place of origin. But Du Toit (1932) found in the Lower Beaufort beds of Natal examples of the same size and form in close association with small spathulate structures which he named *Eretmonia natalensis*. These were 15–35 mm. long with a narrow stalk and a spoon-shaped head; anastomosing veins were faintly visible in the head. I have recently examined these specimens by the kindness of Dr. Crompton, Director of the South African Museum. This material also shows a graded series of leaves referable to *Glossopteris*, the smallest being about 20 mm. long and 7 mm. broad with a rounded apex and a narrow lamina. The sporangia are only seen in the matrix near the Eretmonias, but there is no certain evidence of their attachment. Poorly preserved remains of seeds, comparable in size to those from Lidgetton, also are present.

It seems very probable that *Eretmonia* was a fertile structure from another plant with *Glossopteris* leaves, possibly *G. cordata* Feist. If this is so, *Lidgettonia* and *Eretmonia* may well be related, though they could scarcely be regarded as species of the same genus.

The isolated seeds described above are comparable in form to seeds found in other places associated with *Glossopteris* and *Gangamopteris*, but they differ by being smaller in size. Arber (1905*a*) described winged seeds from India, Australia and South Africa under the name *Cardiocarpus*, and Seward (1917) described somewhat similar forms from a number of places under the name *Samaropsis*. Of the examples described *Samaropsis seixasi* (White) from Brazil would seem to resemble the present forms most closely. It seems to have had a sclerotesta 8–10 mm. long and 5 mm. broad, with a wing which completely surrounded it. Another small seed from Tasmania was mentioned by Arber as having an oval sclerotesta, 5·5 mm.

long with traces of a narrow wing. Walkom (1921) found winged seeds associated with *Glossopteris* in a number of localities in Australia, which he called *Nummulospermum bowenense*. This was a larger structure in which the sclerotesta had a marked nucellar beak, and the sarcotesta, or wing extended all round the seed and was broader in the micropylar region.

Although such winged seeds are often found associated with *Glossopteris* we have no evidence of an original connection. Seeds of a somewhat similar form are known to have been produced by plants of the *Cordaites* type, and Cordaitalean forms often occurred in the Southern Hemisphere with *Glossopteris*. But it is far from certain all the winged forms that have been found were derived from plants allied to *Cordaites*. It seems likely that the seeds of structures like *Scutum* were set free and dispersed when ripe, but we do not yet know their individual form.

CONCLUSION

The collection of *Glossopteris* leaves and the structures associated with them that is here described, adds something to our knowledge of this puzzling form, but does little to elucidate the morphological and taxonomic problems relating to this widespread plant organ of Permian and Early Triassic times. It shows, however, that in addition to the types which bore strobilus-like aggregates of reproductive structures on stout pedicels springing from foliage leaves, there were other forms in which the foliage leaves were accompanied by smaller fertile leaves. In these reproduction was probably effected through the agency of structures produced in small and delicate cupules borne on stalks on the fertile leaves. While there is no direct and indisputable evidence as to the nature of the bodies borne in the cupules, there is considerable likelihood that the cupules contained groups of small elongated sporangia and that small seeds were borne in some of them ; both these structures occur in considerable abundance in the matrix with the fertile leaves. Even if this suggestion as to the probable nature of the actual reproductive organs is rejected as unproven, it is clear that the plant remains at Lidgetton show certain fundamental differences from the older types found in the Middle Ecca rocks at Vereeniging. These differences support the view, based on the study of cuticles, that there were several different groups of plants with leaves whose form and venation has led to their inclusion in the form genus *Glossopteris*. This form of leaf may well have evolved by parallel or even convergent development.

The problems raised by this work can only be solved by the discovery of much well preserved material showing different stages in the growth of the structures which have been described. When the vast extent of the beds containing *Glossopteris* is remembered, the ultimate finding of such material does not seem improbable. But a very careful search will be necessary as it has proved very easy to overlook specimens like those described when collecting in the field.

REFERENCES

ARBER, E. A. N. 1905. On the sprangium-like organs of *Glossopteris browniana*. *Quart. J. Geol. Soc. Lond.*, **61** : 324–338, pls. 30, 31.

—— 1905*a*. *Catalogue of the Fossil Plants of the Glossopteris Flora in the Department of Geology, British Museum (Natural History)*. lxxiv + 255 pp., 8 pls. Brit. Mus. (Nat. Hist.), London.

BRONGNIART, A. 1828. *Prodrome d'une Histoire des Végétaux fossiles.* viii + 223 pp. Paris.
—— 1830. *Histoire des Végétaux fossiles.* **1**, 5 : 209–249.
DU TOIT, A. L. 1927. The Fossil Flora of the Upper Karroo Beds. *Ann. S. Afr. Mus.*, Cape Town, **22** : 289–420, pls. 16–32.
—— 1932. Some Fossil Plants from the Karroo System of South Africa. *Ann. S. Afr. Mus.*, Cape Town, **28** : 370–393, pls. 39, 40.
FEISTMANTEL, O. 1881. Fossil Flora of the Gondwana System. *Palaeont. indica*, Calcutta (2) **3**, 1 (Suppl.) : 49–60.
HARRIS, T. M. 1932. The Fossil Flora of Scoresby Sound, East Greenland, 2. *Medd. Gronland*, København, **85**, 3 : 1–112, pls. 1–9.
LUNDQUIST, G. 1919. Fossile Pflanzen der Glossopteris-Flora aus Brasilien. *K. Svensk., Vet. Akad. Handl*, Stockholm, **60**, 3 : 1–36, pls. 1, 2.
PLUMSTEAD, E. P. 1952. Description of Two New Genera and Six New Species of Fructifications Borne on *Glossopteris* Leaves. *Trans. Geol. Soc. S. Afr.*, Johannesburg, **55** : 281–328, pls. 43–52.
—— 1956. Bisexual fructifications borne on *Glossopteris* leaves from South Africa. *Palaeontographica*, Stuttgart, **100**, B : 1–25, pls. 1–14.
—— 1956*a*. On *Ottokaria*, the Fructification of *Gangamopteris*. *Trans. Geol. Soc. S. Afr.*, Johannesburg, **59** : 211–236, pls. 33–39.
SAHNI, B. 1923. On the structure of the cuticle in *Glossopteris angustifolia* Brongn. *Rec. Geol. Surv. India*, Calcutta, **54** : 277–280, pl. 17.
SEWARD, A. C. 1908. On a collection of Permo-Carboniferous plants from the St. Lucia (Somkele) Coal-field, Zululand, and from the Newcastle district, Natal. *Trans. Geol. Soc. S. Afr.*, Johannesburg, **10** : 65–71, pls. 8, 9.
—— 1917. *Fossil Plants*, **3**. xviii + 656 pp. Cambridge.
SRIVASTAVA, P. N. 1956. Studies in the *Glossopteris* Flora of India, 4. *Glossopteris, Gangamopteris* and *Palaeovittaria* from the Raniganj Coalfield. *Palaeobotanist*, Lucknow, **5** : 1–45, pls. 1–14.
STERNBERG, C. VON. 1838. *Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt*, **2** : 220 pp., 68 pls. Leipzig.
SURANGE, K. R. & SRIVASTAVA, P. N. 1956. Studies in the *Glossopteris* Flora of India, 5. Generic status of *Glossopteris, Gangamopteris* and *Palaeovittaria*. *Palaeobotanist*, Lucknow, **5** : 46–49.
THOMAS, H. HAMSHAW. 1952. A *Glossopteris* with whorled leaves. *Palaeobotanist*, Lucknow, **1** : 435–438, pl. 1.
WALKOM, A. B. 1921. *Nummulospermum bowenense* gen. et. sp. nov. *Quart. J. Geol. Soc. Lond.*, **77** : 289–295, pl. 21.
—— 1928. Notes on some additions to the *Glossopteris* Flora in New South Wales. *Proc. Linn. Soc. N.S.W.*, **53** : 555–564, pl. 36.
ZEILLER, R. 1896. Etudes sur quelques plantes fossiles, en particulier *Vertebraria* et *Glossopteris*, des environs de Johannesburg (Transvaal). *Bull. Soc. géol. Fr.*, Paris (3) **24** : 349–378, pls. 15–18.

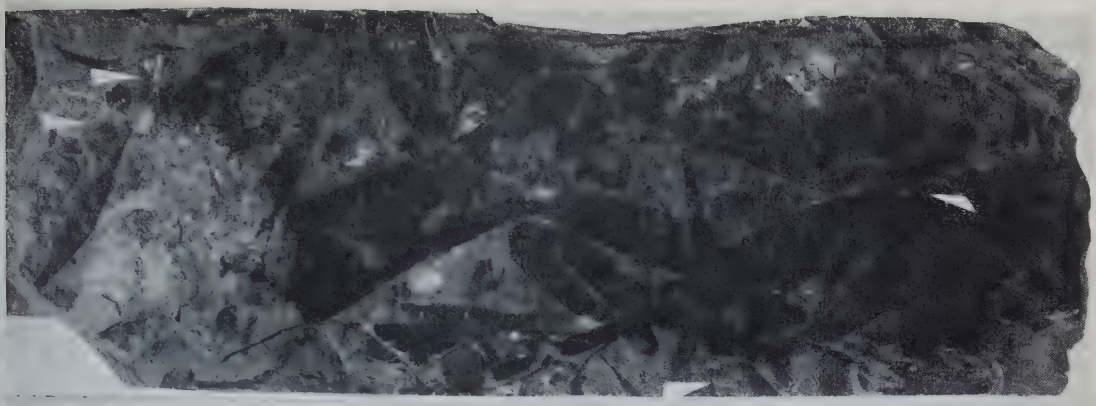
PLATE 22

Lidgettonia africana n.sp.

FIG. 1. Large block of dark grey shale from Lidgetton, containing well preserved remains of parts of sterile leaves. Groups of sporangia occur at the points marked by arrows, and some isolated seeds are present. × 1/3. (V.34637).

FIG. 2. Part of a fertile leaf in light buff shale. Remains of the stalked cupules are shown on the right hand side, and a seed is seen in contact with one of them. × 3. (V.34634.)

FIG. 3. Two series of impressions of stalked cupules are shown in the upper part of the figure, which are believed to have sprung from one fertile leaf, which is not seen. An isolated seed is in the centre of the figure, and a short " scale " leaf which may have been fertile is seen below. ×3. (V.34635.)



1

2

3

LIDGETTONIA AFRICANA

PLATE 23

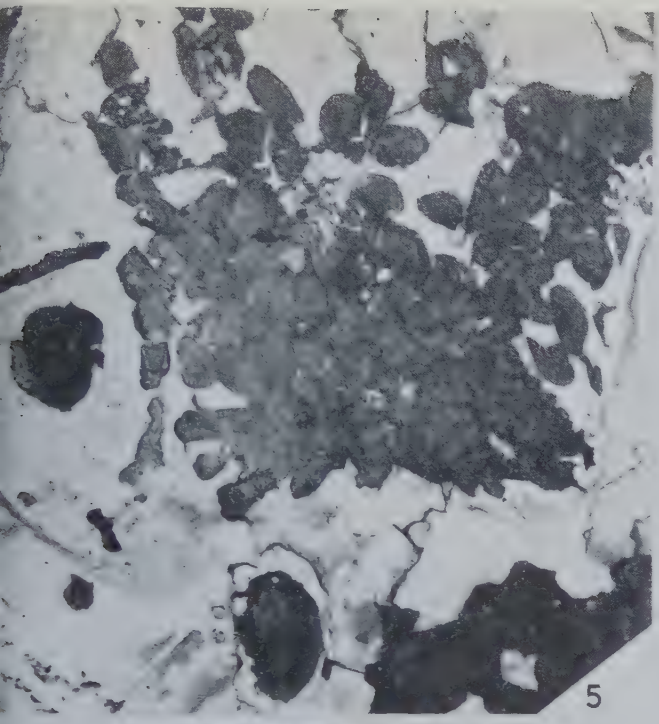
Lidgettonia africana n.sp.

Fig. 4. Holotype. Fertile leaf with some preserved remains of tissues. The remains of broken cupules are seen on either side of the petiole. × 2. (V.34633.)

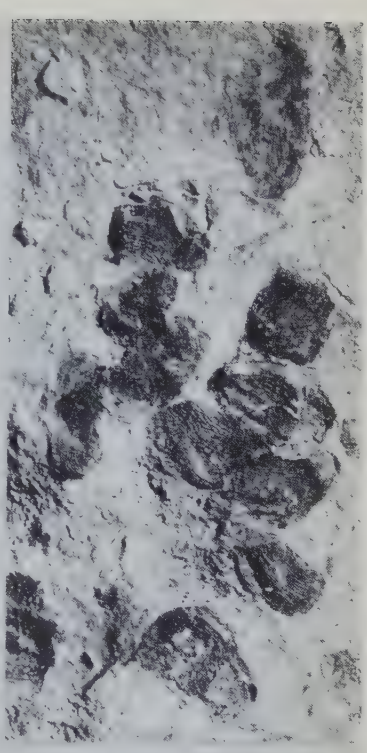
Fig. 5. Large group of sporangia. Remains of two seeds are shown at the bottom and on the left hand side. × 6·5. (V.34636.)

Fig. 6. Group of well preserved sporangia. × 10. (V.34638.)

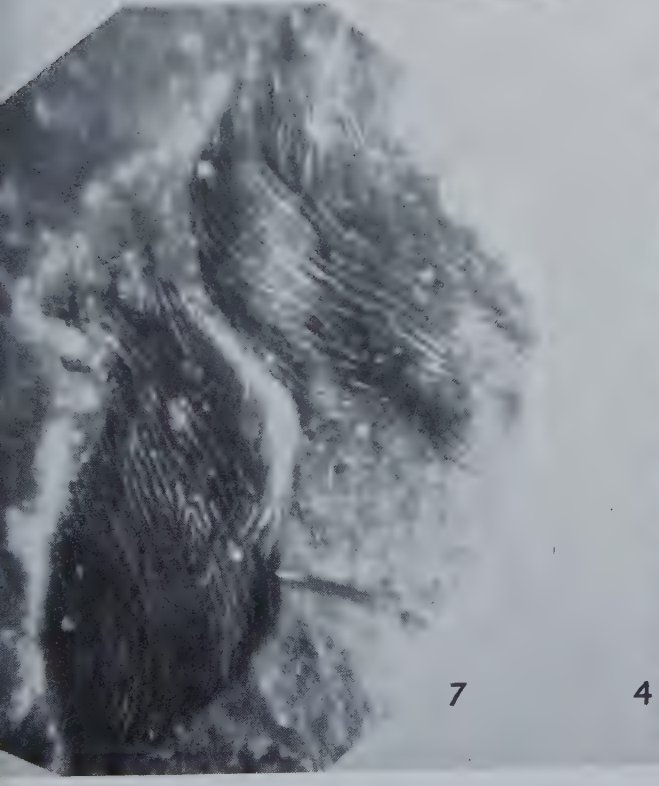
Fig. 7. Remains of two sporangia, which had probably dehisced before preservation. × 60. (V.34638.)



5



6



7

4

LIDGETTONIA AFRICANA

PRINTED IN GREAT BRITAIN BY
ADLARD AND SON, LIMITED,
BARTHOLOMEW PRESS, DORKING